

What is claimed is:

1. A multiple slot antenna comprising:

(a) a first plurality of cards defining a plurality of slots therebetween for  
5 radiating electromagnetic energy therefrom, each card having conductive material  
layer disposed on at least one side of a dielectric material layer, the conductive  
material layer on at least one side of each card in said first plurality of cards  
forming a plano-convex Rotman lens with a plurality of parallel conductors  
emanating therefrom;

10 (b) a second plurality of cards arranged with edges aligned orthogonally to  
the dielectric material layers in the first plurality of cards, the second plurality of  
cards each having conductive material formed on at least one side of a planar  
dielectric element, the conductive material on at least one side of each planar  
dielectric element of the second plurality of cards forming a convex-convex  
15 Rotman lens with a plurality of parallel conductors emanating therefrom; and

(c) the plurality of parallel conductors emanating from the plano-convex  
Rotman lens on a given card in first plurality of cards mating with one of the  
parallel conductors emanating from each convex-convex Rotman lens in the second  
plurality of cards.

20 2. The multiple slot antenna of claim 1 wherein the cards and the conductive  
material formed thereon are provided by etched printed circuit boards.

3. A multiple slot antenna wherein the slots are arranged in a planar  
25 configuration and therein the antenna further comprises a plurality of plano-  
convex Rotman lenses disposed in a stack, each plano-convex Rotman lens in said  
stack having a major surface disposed at an angle to the planar configuration of the  
slots of the antenna, with planar portions of the each Rotman lens defining a  
portion of each one of the slots of the antenna.

4. The multi-slot antenna of claim 3 wherein each plano-convex Rotman lens is disposed on a dielectric layer in said stack, the dielectric constant of each dielectric layer being artificially adjusted adjacent each Rotman lens in said stack.

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5. The multi-slot antenna of claim 4 wherein the dielectric constant of each dielectric layer in the stack is artificially adjusted adjacent each Rotman lens in said stack by providing voids in the dielectric layers adjacent each Rotman lens in said stack.

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6. The multi-slot antenna of claim 4 wherein the dielectric constant of each dielectric layer in the stack is artificially adjusted adjacent each Rotman lens in said stack by providing voids in each Rotman lens in said stack.

15 7. The multi-slot antenna of claim 3 wherein each Rotman lens in said stack has voids therein to adjust delay times in the Rotman lenses.

8. The multi-slot antenna of claim 3 wherein said angle is a 90° angle.

20 9. The multi-slot antenna of claim 3 wherein said angle is an acute angle.

10. An antenna comprising:  
a long slot array; and

a quasi-optical beam forming network constructed as printed circuit boards  
25 arranged in at least two stacks of printed circuit boards, each stack having a Rotman lens formed in a conductive layer associated with each printed circuit board, the Rotman lenses including conductors arranged such that the conductors of each Rotman lens in one stack each directly connect to a conductor associated with a different Rotman lens in another stack, the Rotman lenses of one stack

defining edges of slots of the long slot array.

11. The antenna of claim 10 wherein the at least two stacks of printed circuit boards are arranged in a folded configuration with respect to one another.

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12. The antenna of claim 11 wherein the slots are arranged in a planar configuration and wherein the Rotman lenses of one stack of printed circuit boards have a planar end which defines the slots.

10 13. The antenna of claim 12 wherein the at least two stacks of printed circuit boards are arranged in a folded configuration with respect to one another and with respect to the planar configuration of the slots.

14. The antenna of claim 10 wherein the slots are arranged in a planar  
15 configuration and wherein the Rotman lenses of one stack have a planar end which defines the slots.

15. A method of making an antenna element comprising:

a) etching a Rotman lens into each of a plurality of printed circuit boards,  
20 the etched Rotman lenses each having a plano-convex configuration with a planar edge of each etched Rotman lens being disposed adjacent and parallel to an edge of each of the printed circuit boards;

b) stacking the Rotman lens etched printed circuit boards in a stack with the planar edges of the etched Rotman lenses being adjacent a common edge of  
25 the resulting stack of Rotman lens etched printed circuit boards so that the planar edges of the etched Rotman lenses define a plurality of antenna slots; and

c) resistively coupling the planar edges of the etched Rotman lenses to adjacently disposed planar edges of neighboring etched Rotman lenses at distal ends of the antenna slots.

16. The method of claim 15 wherein the etching of a Rotman lens into each of the plurality of printed circuit boards includes etching a series of parallel conductors extending from a rear edge of the Rotman lens towards a rear surface of the printed circuit board.

17. The method of claim 16 wherein the series of parallel conductors extending from a rear edge of the Rotman lens towards a rear surface of each of the printed circuit boards are disposed in different lateral locations on adjacently disposed printed circuit boards.

18. The method of claim 15 wherein the printed circuit boards each have a dielectric material, which has an effective dielectric constant, the effective dielectric constant of the dielectric material of each board being modified in a region in a vicinity of the planar edge of the Rotman lens by the provision of apertures in a metallic portion of the printed circuit board forming the Rotman lens.

19. The method of claim 15 wherein the printed circuit boards each have a dielectric material, which has an effective dielectric constant, the effective dielectric constant of the dielectric material of each board being modified in a region in a vicinity of the planar edge of the Rotman lens by the provision of apertures in a dielectric portion of the printed circuit board forming the Rotman lens.

20. The method of claim 15 wherein the printed circuit boards each have a dielectric material, which has an effective dielectric constant, the effective dielectric constant of the dielectric material of each board being modified in a region in a vicinity of the planar edge of the Rotman lens in a manner of a planar

Luneberg lens.

21. A plano-convex Rotman lens.

5 22. The plano-convex Rotman lens of claim 21 wherein the Rotman lens has a substrate with an effective dielectric constant which varies in a region immediately adjacent the planar end of the plano-convex Rotman lens due to apertures in the substrate in said region.

10 23. The plano-convex Rotman lens of claim 21 wherein the Rotman lens has a substrate with an effective dielectric constant which varies in a region immediately adjacent the planar end of the plano-convex Rotman lens due to apertures in a metal layer associated with said region.

15 24. A double convex Rotman lens wherein the Rotman lens has a substrate with an effective dielectric constant, the effective dielectric constant of said substrate varying in a region immediately adjacent at least one end of the Rotman lens.

20 25. The double convex Rotman lens of claim 24 wherein the Rotman lens has two convex ends, with one convex end being less convex than the other end and wherein the region with the varying effective dielectric constant is immediately adjacent said one convex end which is less convex than the other end of said Rotman lens.